PTO 03-2750 HAMT

Japanese Patent
Document No. 09-002832

METHOD OF DRAWING FIBER OPTIC AND FIBER OPTIC DRAWING REACTOR

[光ファイバ線引き方法および光ファイバ線引き炉]

Kobayashi Kohei & Ota Hiroaki

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. 04/2003

Translated by: Schreiber Translations, Inc.

Bibliographic Fields
Document Identity
(19) [Publication Office]

Japan Patent Office (JP)

(12) [Kind of Document]

Unexamined Patent Publication (A)

(11) [Publication Number of Unexamined Application]

Japan Unexamined Patent Publication Hei 9 - 2832

(43) [Publication Date of Unexamined Application]

January 7th 1997

(43) [Publication Date of Unexamined Application]

January 7th 1997

(54) [Title of Invention]

METHOD OF DRAWING FIBER OPTIC AND FIBER OPTIC DRAWING REACTOR

(51) [International Patent Classification, 6th Edition]

C03B 37/027

G02B 6/00 356

[FI]

C03B 37/027 Z

G02B 6/00 356 A

[Number of Claims]

5

[Form of Application]

OL

[Number of Pages in Document]

6

[Request for Examination]

Not yet requested

(21) [Application Number]

Japan Patent Application Hei 7 - 156468

(22) [Application Date]

June 22nd 1995

(71) [Applicant]

[Identification Number]

2130

[Name]

SUMITOMO ELECTRIC INDUSTRIES LTD. (DB 69-055-6345)

[Address]

Osaka Prefecture Osaka City Chuo-ku Kitahama 4-5-33

(72) [Inventor]

[Name]

Kobayashi Kohei

[Address]

Kanagawa Prefecture Yokohama City Sakae-ku Taya-cho 1 Sumitomo Electric Industries Ltd. (DB 69-055-6345) Yokohama Works

(72) [Inventor]

[Name]

Ota Hiroaki

[Address]

Kanagawa Prefecture Yokohama City Sakae-ku Taya-cho 1 Sumitomo Electric Industries Ltd. (DB 69-055-6345) Yokohama Works

(74) [Attorney(s) Representing All Applicants]

[Patent Attorney]

[Name]

Valley Yoshikazu (1 other)

(57) [Abstract]

[Objective]

To provide a method of drawing fiber optic and its drawing reactor that is potential of stabilizing fiber optic of uniform diameter and drawing it without supplying large amount of inactive gas inside furnace and by preventing convection phenomena of atmosphere gas inside upper chamber.

[Configuration]

Fiber optic drawing reactor that bears reactor core tube 14 that supplies base material 15 for fiber optic, heater 17 that covers this reactor core tube 14 and upper chamber 24 that has shaft 18 connected to upper edge of reactor core tube 14, containing base material 15 for fiber optic and supporting base material 15 for fiber optic passing through it, is provided with circular shaped thermal insulated heater 34 that covers upper chamber 24 and heats up upper edge of this upper chamber 24.

[Figure; Translation]

35. Regulator

36. Temperature sensor

[Claim(s)]

[Claim 1]

A method of drawing fiber optic wherein fiber optic is drawn by heat-melting the bottom edge of the base material for fiber optic using fiber optic drawing reactor that is provided with a reactor core tube supplying base material for fiber optic, a heater that covers this reactor core tube and a upper chamber that has a passing through shaft, which is connected to upper edge of reactor core tube, and contains and supports the base material for optical

is characterized by the fact that upper edge of the upper chamber is such that it retains the applied heat.

[Claim 2]

A method of drawing fiber optic as mentioned in claim 1is characterized by the fact that upper edge of the upper chamber retains the applied heat in the range of 100deg. C to 700deg.C, preferably in the range of 200deg. C to 400deg.C

[Claim 3]

An fiber optic drawing reactor that bears a reactor core tube supplying base material for fiber optic, a heater that covers this reactor core tube and a upper chamber that has a passing through shaft, which is connected to upper edge of reactor core tube, contains and supports the base material for fiber optic is characterized by the fact that a circular shaped thermal

insulated heater applying heat to upper edge of the upper chamber encloses the upper chamber.

[Claim 4]

An fiber optic drawing reactor as mentioned in claim 3 is characterized by the fact that it is further provided with a temperature sensor that detects the atmosphere temperature of upper edge of the upper chamber and a heater regulating means that regulates the operation of thermal insulated heater based on the detection information from this temperature sensor.

[Claim 5]

An fiber optic drawing reactor as mentioned in claim 4 is characterized by the heater regulating means that

regulates the operation of thermal insulated heater such that atmosphere temperature of upper edge of the upper chamber that is detected by the temperature sensor is in the range of 100 deg. C to 700 deg. C, preferably in the range of 200 deg. C to 400deg. C.

[Detail Description of the Invention]

[0001]

[Field of Industrial Application]

Present invention pertains to a method of drawing fiber optic that obtains the control of cable diameter variations and to an fiber optic reactor that is used in this.

[0002]

[Prior Art]

Usually, an fiber optic is drawn by heat-softening the cylindrical shaped base material for fiber optic in fiber optic reactor and then by stretching.

As one way to reduce the manufacturing cost of this fiber optic, the base material for fiber optic is elongated, replacement at that stage is lessen and continuous drawing operation of fiber optic of hundreds of kilometers length is realized.

[0003]

In fiber optic drawing reactor that is used to pull the elongated base material for fiber optic, as has been disclosed in Japan Unexamined Patent Publication Hei: 2-6349, a chimney shaped upper chamber that contains upper part of this fiber optic base material is formed above reactor core tube that is covered by heater heating up bottom edge of fiber optic base material and a semi closed space is formed continuing inside reactor core tube.

Then, inactive gases such as helium and nitrogen are supplied to upper edge of this upper chamber, upper chamber and internal of reactor core tube communicating with upper chamber are maintained in nonoxidic atmosphere and fiber optic is drawn from the bottom end of fiber optic base material that is in the heat molten state.

[0004]

[Problems to be Solved by the Invention]

In fiber optic drawing reactor that has formed upper chamber, along with the progressing fiber optic drawing operation, base material for fiber optic becomes short and the storage space of fiber optic base material held inside upper chamber becomes vacant gradually.

Because of this inactive gases that are in here flow easily besides the fact that the temperature difference from inactive gases inside reactor core tube becomes larger resulting in the occurrence of convection phenomena of inactive gas from the gap between upper edge of the upper chamber and the periphery of reactor core tube.

[0005]

Thus if convection of inactive gas takes place, the flow of the gas forming atmosphere of bottom edge of the fiber optic base material that is in heat softening state becomes unstable, cable diameter of drawn fiber optic tends to vary largely and it becomes troublesome to obtain the desired quality as a product.

[0006]

In order to prevent inactive gas convection inside upper chamber, supply of inactive gas to upper chamber with such flow velocity that will be able to break this convection phenomena has been proposed in Japan Unexamined Patent Publication Hei: 2-6349.

[0007]

However, in this method as it is necessary to assure the minimum flow velocity of 4.0 to 5m per second, for example, if the internal diameter of reactor core tube and upper chamber is 100mm, in order to form a spiral flow having flow velocity of 0.5m per second along the internal peripheral wall of upper chamber in the length of 50cm in upward and downward direction, it is necessary to supply 281 litters of inactive gas per second with shaft having 25mm diameter.

Even if the cubic content of inactive gas is expanded by number of times due to high temperature atmosphere inside reactor, it is necessary to supply minimum 60-80litters of inactive gas per minute in standard situation and running cost becomes higher.

[0008]

[Objective]

The objective of present invention is to provide a method of drawing fiber optic and its drawing reactor that is potential of stabilizing fiber optic of uniform diameter and drawing it without supplying large amount of inactive gas inside reactor and prevents convection phenomena of atmosphere gas inside upper chamber

[0009]

[Means to Solve the Problems]

The first embodiment of present invention is in the method of drawing fiber optic wherein fiber optic is drawn by heat-melting the bottom edge of the base material for fiber optic using fiber optic drawing reactor that is provided with a reactor core tube supplying base material for fiber optic, a heater that covers this reactor core tube and a upper chamber that has a passing through shaft, which is connected to upper edge of reactor core tube, and contains and supports the base material for optical is characterized by the fact that upper edge of the upper chamber is such that it retains the applied heat.

[0010]

Here it is effective to maintain applied heat in the range of 100deg. C to 700deg.C, preferably in the range of 200deg. C to 400deg.C

[0011]

In addition, the second embodiment of present invention is in fiber optic drawing reactor that An fiber optic drawing reactor that bears a reactor core tube supplying base material for fiber optic, a heater that covers this reactor core tube and a upper chamber that has a passing through shaft, which is connected to upper edge of reactor core tube, contains and supports the base material for fiber optic is characterized by the fact that a circular shaped thermal insulated heater applying heat to upper edge of the upper chamber and encloses the upper chamber is provided.

[0012]

Here it is preferred that it is further provided with a temperature sensor that detects the atmosphere temperature of upper edge of the upper chamber and a heater regulating means that regulates the operation of thermal insulated heater based on the detection information from this temperature sensor, in this case it is

effective to regulate the operation of the thermal insulated heart such that atmosphere temperature of upper edge of the upper chamber that is detected by the temperature sensor is in the range of 100 deg. C to 700 deg. C, preferably in the range of 200 deg. C to 400deg. C.

[0013]

[Operation]

While heating the fiber optic base material with heater, fiber optic is to be drawn from its bottom end and besides the fact that fiber optic base material held inside upper chamber moves in downward direction shaft is fed inside this upper chamber.

Along with the progress of this fiber optic drawing operation, the space inside upper chamber increases gradually and atmosphere temperature here tends to decrease easily.

[0014]

According to present invention, decrease of atmosphere temperature of upper edge of upper chamber is prevented beforehand by applying heat to upper edge of upper chamber with thermal insulated heater.

[0015]

If fiber optic drawing reactor is further provided with a temperature sensor that detects the atmosphere temperature of upper edge of the upper chamber and a heater regulating means that regulates the operation of thermal insulated heater based on the detection information from this temperature sensor, the heater regulating means regulates the operation of thermal insulated heater such that atmosphere temperature of upper edge of the upper chamber that is detected by the temperature sensor is in the range of 100 deg. C to 700 deg. C, preferably in the range of 200 deg. C to 400deg. C and prevents the convection phenomena of atmospheric gas inside upper chamber.

[0016]

[Working Embodiment(s)]

Regarding an embodiment of fiber optic drawing reactor of this invention that can realize the method of drawing fiber optic of this invention is explained

[0017]

As shown in figure 1 indicating cross-sectional structure of fiber optic drawing reactor of this embodiment, around the cylindrical reactor core tube 14 that is provided in the central part of reactor main unit 13 made of stainless steel and lined inside with heat insulating material 12 and which has cooling jacket 11 formed on the periphery, circular shaped carbon heater 17 is provided with reactor core tube 14 concentrically to pull fiber optic 16 by heat melting the bottom edge of fiber optic base material 15 that has been supplied inside this reactor core tube 14

The fiber optic base material 15 is such that the upper edge of fiber optic base material 15 is connected to the bottom edge of shaft 18, the upper edge of this shaft 18 is suspended with chuck that is not shown in figure and along with the drawing of fiber optic 16 it will be fed to reactor core tube 14 sequentially

[0018]

On bottom edge of the reactor core tube 14 elongated part 21 is connected such that it forms lower chamber 20 through inside cooling jacket 19 by projecting in downward direction from reactor unit 12; on the lower end of this elongated part 21 seal plate 23 is installed on the center of which opening 22 is formed such that optic fiber 16 passes through.

On aforementioned two cooling jackets 11 and 19 although not shown in figure, refrigerant circulating device is attached and atmospheric temperature of carbon heater 17, reactor core tube 14 and internal of lower chamber 20 is maintained at predetermined temperature by controlling the supply of refrigerant from this refrigerant circulation device inside cooling jackets 11 and 19

[0019]

In addition, base material container tube 25 forming upper chamber 24 on internal side by projecting in upward direction from reactor unit 12 is connected to the upper edge of reactor core tube 14.

On the periphery of this base material container tube 25 gas inlet tube 27 formed with heat resistant alloy such as inconel covered with heat insulating material 26 is placed.

On the bottom edge of this gas inducting tube 27 not shown in figure, gas supply tube 28 connected to inactive gas supply source is installed and a plurality of gas feeding ports 29 connecting with inside of upper chamber 24 is formed on the upper edge of the base material container tube 25.

[0020]

In other words, the inactive gases such as helium and nitrogen from inactive gas supply source are supplied to upper edge of upper chamber 24 through gas feeding ports 29 from the circular shaped gap formed between gas inlet tube 27 and base material container 25 and the interior of reactor is maintained at inactive gas atmosphere.

[0021]

On the upper edge of the base material container tube 25 and gas inducting tube 27 cover plate 31 that has opening 30 of large diameter formed on it such that base material 15 be able to pass through is installed and on this cover plate 31 shuttering 33 forming opening 32 of small diameter for shaft 18 to pass through is superimposed.

On the upper edge of heat insulating material 26 to retain the temperature inside upper chamber 24, circular shaped heat thermal insulated heater 34 that applies heat to the upper edge of upper chamber 24 and covers upper edge of this heat insulating material 26 is installed and on this thermal insulated heater 34, regulator device to regulate the on/off of electric power for said thermal insulated heater 34 is connected.

In this regulator device 35, temperature sensor 36 detecting the atmospheric temperature of upper edge of upper chamber 24 is attached such that the detection information from this temperature sensor 36 is being outputted to regulator device 35.

[0022]

And, upper edge of upper chamber 24 is heated appropriately with thermal insulated heater 34 such that heat convection of atmospheric gas between the part covered by upper part of upper chamber 24 and reactor core tube 14.

[0023]

Meanwhile, temperature distribution state inside the reactor alongside of upper edge to lower edge of the reactor at the time of completion of drawing operation from fiber optic base material 15 is shown in figure 2.

Solid line shows the situation of present invention, dotted line shows the conventional situation wherein thermal insulated heater 34 is not used.

In other words, in the conventional fiber optic drawing reactor that does not use thermal insulated heater 34, it is understood that at the time when drawing operation from fiber optic base material 15 is completed, the temperature of upper part of upper chamber 24 decreases up to less than 100 deg. C.

[0024]

In addition, the temperature variation of upper chamber central part concurrent with drawing operation process is shown in figure 3.

Same as in figure 2 solid line shows the situation of present invention, dotted line shows the conventional situation wherein thermal insulated heater 34 is not used.

This is the case when fiber optic base material 15 of 80mm length is used, if that excess length is below than half of initial, it was understood that in conventional reactor for fiber optic drawing the temperature of up and down direction central part of upper chamber 24 decreases sharply.

[0025]

Furthermore, change in variation volume of external diameter dimension of drawn fiber optic 16 is shown in figure 4.

Same as in figure 2 and 3 solid line shows the situation of present invention, dotted line shows the conventional situation wherein thermal insulated heater 34 is not used.

According to figure 4, if the excess length of fiber optic base material 15 is under the half of the beginning it is understood that variation volume of external diameter dimension of fiber optic 16 increases gradually.

[0026]

In this connection, when the fiber optic 16 with external diameter of 125μ m was formed by using fiber optic drawing reactor shown in figure 1 and without supplying electricity to thermal insulated heater 34 and as a result of examining relation between the atmospheric temperature of upper edge of upper chamber 24 and variation volume of external diameter dimension of drawn fiber optic 16, correlation as shown in figure 5 could be obtained.

[0027]

From the result above, if the atmospheric temperature of upper part of upper chamber 24 of fiber optic drawing reactor is under 100 deg. C, as the variation volume of external diameter dimension of fiber optic 16 increases to more than ± 0.4μ m, it is necessary to maintain the atmospheric temperature of upper edge of upper chamber 24 of fiber optic drawing reactor to more than 100 deg. C

Especially, when it is necessary for variation volume to be below ± 0.2 μ m, it is preferred to maintain the atmospheric temperature of upper edge of upper chamber 24 to more than 200 deg. C.

In addition, if the atmospheric temperature of upper edge of upper chamber 24 is maintained at 400 deg. C, it is possible to control the variation volume of external diameter dimension of fiber optic 16 to under ± 0.1μ m but, even if the temperature is maintained at more than 700 deg. C variation volume of external diameter dimension of fiber optic 16 does not improve more than that, therefore it is effective to maintain the atmospheric temperature of upper edge of upper chamber 24 in the range of 100 to 700 deg. C, preferably in the range of 200 deg. C to 400 deg. C.

[0028]

Herewith, aforementioned regulating device 35 based on the detection information from temperature sensor 36 controls the on/off for thermal insulated heater 34 such that it will maintain the atmospheric temperature

of upper part of upper chamber 24 at about 300 deg. C and cable diameter variation volume of fiber optic 16 becomes ± 0.1μ m

[0029]

[Effects of the Invention]

According to the method of drawing fiber optic and its device, as the circular shaped thermal insulated heater is provided covering the upper chamber and heating the upper edge of this upper chamber, if the fiber optic base material becomes short and containing space of fiber optic base material inside held inside upper chamber becomes empty gradually, because it is possible to lessen the temperature difference of inactive gas inside reactor core tube by heating and insulating upper part of the upper chamber, control of convection phenomena of inactive gas in the gap between the periphery of reactor core tube and the upper part of upper chamber becomes possible.

Hence, it is possible to manufacture a good quality fiber optic that has less variation volume for the whole length of fiber optic base material and is stabilized.

[Brief Explanation of the Drawing(s)]

[Figure 1]

Figure 1 is a sectional diagram showing configuration concept of the first embodiment of fiber optic drawing reactor according to present invention that enables the realization of the method of this invention.

[Figure 2]

Figure 2 is a graph showing temperature distribution along the upward and downward direction of embodiment and conventional fiber optic drawing reactor respectively shown in figure 1 wherein excess length of fiber optic base material has become short.

[Figure 3]

Figure 3 is a graph showing temperature change in upper edge of upper chamber pertaining to embodiment and conventional fiber optic drawing reactor respectively, shown in figure 1

[Figure 4]

Figure 4 is a graph showing the process of cable diameter variation of fiber optic pertaining to the embodiment and conventional fiber optic drawing reactor respectively shown in figure 1.

[Figure 5]

It is a graph showing the relation between the atmospheric temperature of upper edge of upper chamber and cable diameter variation of fiber optic.

[Explanation of Symbols in Drawings]

11

Cooling jacket

12

Insulation

13	Reactor body
14	Reactor core tube
15	Fiber optic base material
16	Fiber optic
17	Carbon heater
18	Shaft
19	Cooling jacket
20	Bottom chamber
21	Elongated tube
22	Opening
23	Seal sheet
24	Upper chamber
25	Base material holding tube
26	Insulation

27

Gas inlet tube

28

Gas supply tube

29

Gas inlet

30

Opening

31

Cover plate

32

Opening

33

Shutter ring

34

Thermal insulated heater

35

Regulator

36

Temperature sensor

Drawings

[Figure 1]

[Figure 1: Translation]

35. Regulator

36. Temperature sensor

[Figure 2]

[Figure 3]

[Figure 4]

[Figure 5]